Geophysical Research Abstracts
Vol. 17, EGU2015-643, 2015
EGU General Assembly 2015

In-situ Nd isotope measurements on accessory minerals: Insights into isotope equilibration during metamorphism

Johannes Hammerli (1), Carl Spandler (2), Tony Kemp (1), and Cassian Pirard (2)

(1) Centre for Exploration Targeting, School of Earth and Environment, The University of Western Australia (johannes.hammerli@uwa.edu.au), (2) Economic Geology Research Unit, School of Earth and Environmental Sciences, James Cook University, Townsville, Australia

Understanding isotope equilibration processes during metamorphism has huge implications for a range of geoscience applications, ranging from provenance studies of sedimentary units to the origin of magmas and ore bodies. Furthermore, recent claims of isotope disequilibrium situations during the melting of continental crust have questioned the reliability of using certain isotope systems to track magma sources. Our recent work investigated a prograde sequence of high-temperature, low-pressure (350–650 ˚C, ∼3-5 kbar) metasedimentary rocks from the Mt. Lofty Ranges, South Australia that underwent widespread pervasive fluid flow at peak metamorphism. In situ Nd-isotope analyses by LA-MC-ICP-MS found that the detrital signature of apatite survives temperatures of 500 ºC. However, the observed isotope equilibration of REE-bearing accessory minerals at ∼600 ºC, before the onset of partial melting, suggests that isotope disequilibrium is unlikely during high-grade metamorphism of upper crustal rocks where fluid induced melting takes place. Here, we extend our research to metasedimentary rocks from (ultra)-high pressure metamorphic terrains from northern New Caledonia, and Dabieshan, China that represent pressure and temperature conditions found in subduction zones. Our study helps to understand isotope equilibration processes from heterogeneous protoliths as well as the impact of retrogression and the resetting of isotope systems over a pressure-temperature range from ∼350 ºC to 700 ºC and ∼15 kbar to 40 kbar. Nd isotope analyses of apatite, allanite, titanite, xenotime, monazite, lawsonite and epidote in pelitic and psammitic samples allow the investigation of isotope equilibration on a mineral and sub-mineral scale, as well as comparison with traditional bulk rock isotope analyses. Our preliminary results show that under high-pressure conditions (∼20 to 30 kbar) and temperatures to ∼650 ºC, REE-bearing phases show variable εNd values in some cases. These differences cannot be simply explained with retrogressive processes and the partial resetting of the isotope system. The results rather suggest that isotopic exchange between different REE-phases in such systems might be limited, and hence heterogeneous isotope signatures of protolithic sedimentary rocks can survive to great depths in subduction-zone environments. These results may have bearing on the reliability of isotopic tracking of the subducted slab component of arc magmas.